This key should allow you to understand why you choose the option you did (beyond just getting a question right or wrong). More instructions on how to use this key can be found here.

If you have a suggestion to make the keys better, please fill out the short survey here.

Note: This key is auto-generated and may contain issues and/or errors. The keys are reviewed after each exam to ensure grading is done accurately. If there are issues (like duplicate options), they are noted in the offline gradebook. The keys are a work-in-progress to give students as many resources to improve as possible.

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1. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$(-7 + 4i)(10 + 3i)$$

The solution is $-82 + 19i$, which is option A.

A. $a \in [-86, -81]$ and $b \in [19, 20]$

* $-82 + 19i$, which is the correct option.

B. $a \in [-61, -57]$ and $b \in [-65, -58]$

$-58 - 61i$, which corresponds to adding a minus sign in the first term.

C. $a \in [-86, -81]$ and $b \in [-19, -15]$

$-82 - 19i$, which corresponds to adding a minus sign in both terms.

D. $a \in [-71, -69]$ and $b \in [11, 16]$

$-70 + 12i$, which corresponds to just multiplying the real terms to get the real part of the solution and the coefficients in the complex terms to get the complex part.

E. $a \in [-61, -57]$ and $b \in [56, 65]$

$-58 + 61i$, which corresponds to adding a minus sign in the second term.

General Comment: You can treat i as a variable and distribute. Just remember that $i^2 = -1$, so you can continue to reduce after you distribute.

---

2. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$\frac{-45 + 66i}{-3 - 8i}$$

The solution is $-5.38 - 7.64i$, which is option A.

A. $a \in [-6, -4.5]$ and $b \in [-7.9, -7.2]$

* $-5.38 - 7.64i$, which is the correct option.

B. $a \in [-394, -390.5]$ and $b \in [-7.9, -7.2]$

$-393.00 - 7.64i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

C. $a \in [8, 9.5]$ and $b \in [2, 2.55]$

$9.08 + 2.22i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

D. $a \in [13.5, 17]$ and $b \in [-8.6, -7.9]$

$15.00 - 8.25i$, which corresponds to just dividing the first term by the first term and the second by the second.

E. $a \in [-6, -4.5]$ and $b \in [-558.05, -557.25]$

$-5.38 - 558.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

General Comment: Multiply the numerator and denominator by the *conjugate* of the denominator, then simplify. For example, if we have $2 + 3i$, the conjugate is $2 - 3i$.

---

3. Choose the **smallest** set of Real numbers that the number below belongs to.

$$-\sqrt{\frac{25921}{529}}$$

The solution is Integer, which is option E.

A. Whole

These are the counting numbers with 0 (0, 1, 2, 3, ...)

B. Not a Real number

These are Nonreal Complex numbers **OR** things that are not numbers (e.g., dividing by 0).

C. Rational

These are numbers that can be written as fraction of Integers (e.g., -2/3)

D. Irrational

These cannot be written as a fraction of Integers.

E. Integer

* This is the correct option!

General Comment: First, you **NEED** to simplify the expression. This question simplifies to -161.

Be sure you look at the simplified fraction and not just the decimal expansion. Numbers such as 13, 17, and 19 provide **long but repeating/terminating decimal expansions!**

The only ways to *not* be a Real number are: dividing by 0 or taking the square root of a negative number.

Irrational numbers are more than just square root of 3: adding or subtracting values from square root of 3 is also irrational.

---

4. Simplify the expression below and choose the interval the simplification is contained within.

$$9 - 1 \div 8 * 2 - (4 * 6)$$

The solution is -15.250, which is option A.

A. $[-15.72, -15.08]$

* -15.250, which is the correct option.

B. $[28.19, 28.67]$

28.500, which corresponds to not distributing a negative correctly.

C. $[32.92, 32.95]$

32.938, which corresponds to not distributing addition and subtraction correctly.

D. $[-15.17, -14.51]$

-15.062, which corresponds to an Order of Operations error: not reading left-to-right for multiplication/division.

E. None of the above

You may have gotten this by making an unanticipated error. If you got a value that is not any of the others, please let the coordinator know so they can help you figure out what happened.

General Comment: While you may remember (or were taught) PEMDAS is done in order, it is actually done as P/E/MD/AS. When we are at MD or AS, we read left to right.

---

5. Choose the **smallest** set of Real numbers that the number below belongs to.

$$-\sqrt{\frac{50625}{625}}$$

The solution is Integer, which is option C.

A. Rational

These are numbers that can be written as fraction of Integers (e.g., -2/3)

B. Whole

These are the counting numbers with 0 (0, 1, 2, 3, ...)

C. Integer

* This is the correct option!

D. Not a Real number

These are Nonreal Complex numbers **OR** things that are not numbers (e.g., dividing by 0).

E. Irrational

These cannot be written as a fraction of Integers.

General Comment: First, you **NEED** to simplify the expression. This question simplifies to -225.

Be sure you look at the simplified fraction and not just the decimal expansion. Numbers such as 13, 17, and 19 provide **long but repeating/terminating decimal expansions!**

The only ways to *not* be a Real number are: dividing by 0 or taking the square root of a negative number.

Irrational numbers are more than just square root of 3: adding or subtracting values from square root of 3 is also irrational.

---

6. Simplify the expression below and choose the interval the simplification is contained within.

$$17 - 13^2 + 9 \div 8 * 20 \div 15$$

The solution is -150.500, which is option A.

A. $[-151.9, -148.6]$

* -150.500, this is the correct option

B. $[-153.6, -151.4]$

-151.996, which corresponds to an Order of Operations error: not reading left-to-right for multiplication/division.

C. $[185.5, 187.3]$

186.004, which corresponds to two Order of Operations errors.

D. $[186.3, 188.4]$

187.500, which corresponds to an Order of Operations error: multiplying by negative before squaring. For example: $(-3)^2 \neq -3^2$

E. None of the above

You may have gotten this by making an unanticipated error. If you got a value that is not any of the others, please let the coordinator know so they can help you figure out what happened.

General Comment: While you may remember (or were taught) PEMDAS is done in order, it is actually done as P/E/MD/AS. When we are at MD or AS, we read left to right.

---

7. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$(-2 - 6i)(-10 + 5i)$$

The solution is $50 + 50i$, which is option A.

A. $a \in [50, 52]$ and $b \in [50, 51]$

* $50 + 50i$, which is the correct option.

B. $a \in [-15, -6]$ and $b \in [-72, -63]$

$-10 - 70i$, which corresponds to adding a minus sign in the first term.

C. $a \in [-15, -6]$ and $b \in [67, 73]$

$-10 + 70i$, which corresponds to adding a minus sign in the second term.

D. $a \in [19, 21]$ and $b \in [-37, -23]$

$20 - 30i$, which corresponds to just multiplying the real terms to get the real part of the solution and the coefficients in the complex terms to get the complex part.

E. $a \in [50, 52]$ and $b \in [-51, -49]$

$50 - 50i$, which corresponds to adding a minus sign in both terms.

General Comment: You can treat i as a variable and distribute. Just remember that $i^2 = -1$, so you can continue to reduce after you distribute.

---

8. Choose the **smallest** set of Complex numbers that the number below belongs to.

$$\sqrt{\frac{0}{7}} + \sqrt{3}i$$

The solution is Pure Imaginary, which is option A.

A. Pure Imaginary

* This is the correct option!

B. Not a Complex Number

This is not a number. The only non-Complex number we know is dividing by 0 as this is not a number!

C. Nonreal Complex

This is a Complex number ($a + bi$) that is not Real (has i as part of the number).

D. Rational

These are numbers that can be written as fraction of Integers (e.g., -2/3 + 5)

E. Irrational

These cannot be written as a fraction of Integers. Remember: π is not an Integer!

General Comment: Be sure to simplify $i^2 = -1$. This may remove the imaginary portion for your number. If you are having trouble, you may want to look at the *Subgroups of the Real Numbers* section.

---

9. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$\frac{-45 + 88i}{4 - 6i}$$

The solution is $-13.62 + 1.58i$, which is option E.

A. $a \in [-14, -13]$ and $b \in [81, 82.5]$

$-13.62 + 82.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

B. $a \in [5, 7]$ and $b \in [11.5, 13]$

$6.69 + 11.96i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

C. $a \in [-708.5, -707.5]$ and $b \in [0.5, 2.5]$

$-708.00 + 1.58i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

D. $a \in [-11.5, -9.5]$ and $b \in [-15.5, -14]$

$-11.25 - 14.67i$, which corresponds to just dividing the first term by the first term and the second by the second.

E. $a \in [-14, -13]$ and $b \in [0.5, 2.5]$

* $-13.62 + 1.58i$, which is the correct option.

General Comment: Multiply the numerator and denominator by the *conjugate* of the denominator, then simplify. For example, if we have $2 + 3i$, the conjugate is $2 - 3i$.

---

10. Choose the **smallest** set of Complex numbers that the number below belongs to.

$$\sqrt{\frac{169}{0}} + \sqrt{221}i$$

The solution is Not a Complex Number, which is option C.

A. Rational

These are numbers that can be written as fraction of Integers (e.g., -2/3 + 5)

B. Irrational

These cannot be written as a fraction of Integers. Remember: π is not an Integer!

C. Not a Complex Number

* This is the correct option!

D. Pure Imaginary

This is a Complex number $(a + bi)$ that **only** has an imaginary part like $2i$.

E. Nonreal Complex

This is a Complex number $(a + bi)$ that is not Real (has i as part of the number).

General Comment: Be sure to simplify $i^2 = -1$. This may remove the imaginary portion for your number. If you are having trouble, you may want to look at the *Subgroups of the Real Numbers* section.

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11. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$(10 - 3i)(8 - 9i)$$

The solution is $53 - 114i$, which is option D.

A. $a \in [103, 114]$ and $b \in [-71, -59]$

$107 - 66i$, which corresponds to adding a minus sign in the first term.

B. $a \in [75, 82]$ and $b \in [22, 30]$

$80 + 27i$, which corresponds to just multiplying the real terms to get the real part of the solution and the coefficients in the complex terms to get the complex part.

C. $a \in [103, 114]$ and $b \in [66, 68]$

$107 + 66i$, which corresponds to adding a minus sign in the second term.

D. $a \in [50, 58]$ and $b \in [-115, -111]$

* $53 - 114i$, which is the correct option.

E. $a \in [50, 58]$ and $b \in [114, 116]$

$53 + 114i$, which corresponds to adding a minus sign in both terms.

General Comment: You can treat i as a variable and distribute. Just remember that $i^2 = -1$, so you can continue to reduce after you distribute.

---

12. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$\frac{54 - 22i}{5 + 4i}$$

The solution is $4.44 - 7.95i$, which is option B.

A. $a \in [10.5, 11]$ and $b \in [-6, -5]$

$10.80 - 5.50i$, which corresponds to just dividing the first term by the first term and the second by the second.

B. $a \in [4, 5]$ and $b \in [-9, -7]$

* $4.44 - 7.95i$, which is the correct option.

C. $a \in [4, 5]$ and $b \in [-327, -325.5]$

$4.44 - 326.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

D. $a \in [181, 183]$ and $b \in [-9, -7]$

$182.00 - 7.95i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

E. $a \in [8, 10]$ and $b \in [1.5, 3.5]$

$8.73 + 2.59i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

General Comment: Multiply the numerator and denominator by the *conjugate* of the denominator, then simplify. For example, if we have $2 + 3i$, the conjugate is $2 - 3i$.

---

13. Choose the **smallest** set of Real numbers that the number below belongs to.

$$-\sqrt{\frac{484}{169}}$$

The solution is Rational, which is option B.

A. Not a Real number

These are Nonreal Complex numbers **OR** things that are not numbers (e.g., dividing by 0).

B. Rational

* This is the correct option!

C. Integer

These are the negative and positive counting numbers (..., -3, -2, -1, 0, 1, 2, 3, ...)

D. Irrational

These cannot be written as a fraction of Integers.

E. Whole

These are the counting numbers with 0 (0, 1, 2, 3, ...)

General Comment: First, you **NEED** to simplify the expression. This question simplifies to $-\frac{22}{13}$.

Be sure you look at the simplified fraction and not just the decimal expansion. Numbers such as 13, 17, and 19 provide **long but repeating/terminating decimal expansions!**

The only ways to *not* be a Real number are: dividing by 0 or taking the square root of a negative number.

Irrational numbers are more than just square root of 3: adding or subtracting values from square root of 3 is also irrational.

---

14. Simplify the expression below and choose the interval the simplification is contained within.

$$9 - 2^2 + 10 \div 8 * 14 \div 20$$

The solution is 5.875, which is option C.

A. $[12.54, 13.05]$

13.004, which corresponds to two Order of Operations errors.

B. $[13.09, 14.05]$

13.875, which corresponds to an Order of Operations error: multiplying by negative before squaring. For example: $(-3)^2 \neq -3^2$

C. $[5.54, 5.99]$

* 5.875, this is the correct option

D. $[4.75, 5.51]$

5.004, which corresponds to an Order of Operations error: not reading left-to-right for multiplication/division.

E. None of the above

You may have gotten this by making an unanticipated error. If you got a value that is not any of the others, please let the coordinator know so they can help you figure out what happened.

General Comment: While you may remember (or were taught) PEMDAS is done in order, it is actually done as P/E/MD/AS. When we are at MD or AS, we read left to right.

---

15. Choose the **smallest** set of Real numbers that the number below belongs to.

$$\sqrt{\frac{144}{625}}$$

The solution is Rational, which is option E.

A. Integer

These are the negative and positive counting numbers (..., -3, -2, -1, 0, 1, 2, 3, ...)

B. Irrational

These cannot be written as a fraction of Integers.

C. Not a Real number

These are Nonreal Complex numbers **OR** things that are not numbers (e.g., dividing by 0).

D. Whole

These are the counting numbers with 0 (0, 1, 2, 3, ...)

E. Rational

* This is the correct option!

General Comment: First, you **NEED** to simplify the expression. This question simplifies to $\frac{12}{25}$.

Be sure you look at the simplified fraction and not just the decimal expansion. Numbers such as 13, 17, and 19 provide **long but repeating/terminating decimal expansions!**

The only ways to *not* be a Real number are: dividing by 0 or taking the square root of a negative number.

Irrational numbers are more than just square root of 3: adding or subtracting values from square root of 3 is also irrational.

---

16. Simplify the expression below and choose the interval the simplification is contained within.

$$2 - 10^2 + 12 \div 18 * 16 \div 9$$

The solution is -96.815, which is option D.

A. $[101.69, 103.16]$

102.005, which corresponds to two Order of Operations errors.

B. $[102.58, 103.51]$

103.185, which corresponds to an Order of Operations error: multiplying by negative before squaring. For example: $(-3)^2 \neq -3^2$

C. $[-98.17, -97.88]$

-97.995, which corresponds to an Order of Operations error: not reading left-to-right for multiplication/division.

D. $[-97.84, -95.36]$

* -96.815, this is the correct option

E. None of the above

You may have gotten this by making an unanticipated error. If you got a value that is not any of the others, please let the coordinator know so they can help you figure out what happened.

General Comment: While you may remember (or were taught) PEMDAS is done in order, it is actually done as P/E/MD/AS. When we are at MD or AS, we read left to right.

---

17. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$(-2 + 6i)(-3 - 4i)$$

The solution is $30 - 10i$, which is option B.

A. $a \in [-18, -17]$ and $b \in [-27.7, -25.5]$

$-18 - 26i$, which corresponds to adding a minus sign in the second term.

B. $a \in [30, 38]$ and $b \in [-11.3, -7.5]$

* $30 - 10i$, which is the correct option.

C. $a \in [30, 38]$ and $b \in [8.5, 13.4]$

$30 + 10i$, which corresponds to adding a minus sign in both terms.

D. $a \in [-18, -17]$ and $b \in [24.7, 27.8]$

$-18 + 26i$, which corresponds to adding a minus sign in the first term.

E. $a \in [6, 9]$ and $b \in [-25.9, -21.2]$

$6 - 24i$, which corresponds to just multiplying the real terms to get the real part of the solution and the coefficients in the complex terms to get the complex part.

General Comment: You can treat i as a variable and distribute. Just remember that $i^2 = -1$, so you can continue to reduce after you distribute.

---

18. Choose the **smallest** set of Complex numbers that the number below belongs to.

$$\sqrt{\frac{1820}{10}} + 10i^2$$

The solution is Irrational, which is option A.

A. Irrational

* This is the correct option!

B. Pure Imaginary

This is a Complex number $(a + bi)$ that **only** has an imaginary part like $2i$.

C. Rational

These are numbers that can be written as fraction of Integers (e.g., -2/3 + 5)

D. Nonreal Complex

This is a Complex number $(a + bi)$ that is not Real (has i as part of the number).

E. Not a Complex Number

This is not a number. The only non-Complex number we know is dividing by 0 as this is not a number!

General Comment: Be sure to simplify $i^2 = -1$. This may remove the imaginary portion for your number. If you are having trouble, you may want to look at the *Subgroups of the Real Numbers* section.

---

19. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$\frac{45 + 44i}{-6 + 8i}$$

The solution is $0.82 - 6.24i$, which is option D.

A. $a \in [-6.5, -4.5]$ and $b \in [-1, 1.5]$

$-6.22 + 0.96i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

B. $a \in [-8, -7]$ and $b \in [4.5, 6.5]$

$-7.50 + 5.50i$, which corresponds to just dividing the first term by the first term and the second by the second.

C. $a \in [81.5, 83]$ and $b \in [-7, -5.5]$

$82.00 - 6.24i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

D. $a \in [-1, 1.5]$ and $b \in [-7, -5.5]$

* $0.82 - 6.24i$, which is the correct option.

E. $a \in [-1, 1.5]$ and $b \in [-625.5, -622.5]$

$0.82 - 624.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

General Comment: Multiply the numerator and denominator by the *conjugate* of the denominator, then simplify. For example, if we have $2 + 3i$, the conjugate is $2 - 3i$.

---

20. Choose the **smallest** set of Complex numbers that the number below belongs to.

$$\sqrt{\frac{36}{0}} + \sqrt{238}i$$

The solution is Not a Complex Number, which is option D.

A. Nonreal Complex

This is a Complex number $(a + bi)$ that is not Real (has i as part of the number).

B. Rational

These are numbers that can be written as fraction of Integers (e.g., -2/3 + 5)

C. Irrational

These cannot be written as a fraction of Integers. Remember: π is not an Integer!

D. Not a Complex Number

* This is the correct option!

E. Pure Imaginary

This is a Complex number $(a + bi)$ that **only** has an imaginary part like $2i$.

General Comment: Be sure to simplify $i^2 = -1$. This may remove the imaginary portion for your number. If you are having trouble, you may want to look at the *Subgroups of the Real Numbers* section.

---

21. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$(6 - 10i)(8 + 2i)$$

The solution is $68 - 68i$, which is option B.

A. $a \in [67, 73]$ and $b \in [68, 74]$

$68 + 68i$, which corresponds to adding a minus sign in both terms.

B. $a \in [67, 73]$ and $b \in [-69, -62]$

* $68 - 68i$, which is the correct option.

C. $a \in [26, 32]$ and $b \in [-95, -86]$

$28 - 92i$, which corresponds to adding a minus sign in the second term.

D. $a \in [48, 51]$ and $b \in [-21, -19]$

$48 - 20i$, which corresponds to just multiplying the real terms to get the real part of the solution and the coefficients in the complex terms to get the complex part.

E. $a \in [26, 32]$ and $b \in [89, 94]$

$28 + 92i$, which corresponds to adding a minus sign in the first term.

General Comment: You can treat i as a variable and distribute. Just remember that $i^2 = -1$, so you can continue to reduce after you distribute.

---

22. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$\frac{-9 - 33i}{4 + 6i}$$

The solution is $-4.50 - 1.50i$, which is option D.

A. $a \in [-234.5, -233]$ and $b \in [-2, 0]$

$-234.00 - 1.50i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

B. $a \in [2, 4]$ and $b \in [-4, -2.5]$

$3.12 - 3.58i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

C. $a \in [-5, -4]$ and $b \in [-79, -77]$

$-4.50 - 78.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

D. $a \in [-5, -4]$ and $b \in [-2, 0]$

* $-4.50 - 1.50i$, which is the correct option.

E. $a \in [-2.5, -2]$ and $b \in [-7, -4]$

$-2.25 - 5.50i$, which corresponds to just dividing the first term by the first term and the second by the second.

General Comment: Multiply the numerator and denominator by the *conjugate* of the denominator, then simplify. For example, if we have $2 + 3i$, the conjugate is $2 - 3i$.

---

23. Choose the **smallest** set of Real numbers that the number below belongs to.

$$-\sqrt{\frac{361}{196}}$$

The solution is Rational, which is option A.

A. Rational

* This is the correct option!

B. Not a Real number

These are Nonreal Complex numbers **OR** things that are not numbers (e.g., dividing by 0).

C. Whole

These are the counting numbers with 0 (0, 1, 2, 3, ...)

D. Irrational

These cannot be written as a fraction of Integers.

E. Integer

These are the negative and positive counting numbers (..., -3, -2, -1, 0, 1, 2, 3, ...)

General Comment: First, you **NEED** to simplify the expression. This question simplifies to $-\frac{19}{14}$.

Be sure you look at the simplified fraction and not just the decimal expansion. Numbers such as 13, 17, and 19 provide **long but repeating/terminating decimal expansions!**

The only ways to *not* be a Real number are: dividing by 0 or taking the square root of a negative number.

Irrational numbers are more than just square root of 3: adding or subtracting values from square root of 3 is also irrational.

---

24. Simplify the expression below and choose the interval the simplification is contained within.

$$16 - 14^2 + 3 \div 10 * 20 \div 8$$

The solution is -179.250, which is option A.

A. $[-179.98, -179.06]$

* -179.250, this is the correct option

B. $[211.55, 212.23]$

212.002, which corresponds to two Order of Operations errors.

C. $[-180.46, -179.51]$

-179.998, which corresponds to an Order of Operations error: not reading left-to-right for multiplication/division.

D. $[212.7, 213.41]$

212.750, which corresponds to an Order of Operations error: multiplying by negative before squaring. For example: $(-3)^2 \neq -3^2$

E. None of the above

You may have gotten this by making an unanticipated error. If you got a value that is not any of the others, please let the coordinator know so they can help you figure out what happened.

General Comment: While you may remember (or were taught) PEMDAS is done in order, it is actually done as P/E/MD/AS. When we are at MD or AS, we read left to right.

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25. Choose the **smallest** set of Real numbers that the number below belongs to.

$$\sqrt{\frac{49}{529}}$$

The solution is Rational, which is option A.

A. Rational

* This is the correct option!

B. Integer

These are the negative and positive counting numbers (..., -3, -2, -1, 0, 1, 2, 3, ...)

C. Irrational

These cannot be written as a fraction of Integers.

D. Not a Real number

These are Nonreal Complex numbers **OR** things that are not numbers (e.g., dividing by 0).

E. Whole

These are the counting numbers with 0 (0, 1, 2, 3, ...)

General Comment: First, you **NEED** to simplify the expression. This question simplifies to $\frac{7}{23}$.

Be sure you look at the simplified fraction and not just the decimal expansion. Numbers such as 13, 17, and 19 provide **long but repeating/terminating decimal expansions!**

The only ways to *not* be a Real number are: dividing by 0 or taking the square root of a negative number.

Irrational numbers are more than just square root of 3: adding or subtracting values from square root of 3 is also irrational.

---

26. Simplify the expression below and choose the interval the simplification is contained within.

$$9 - 14^2 + 4 \div 16 * 15 \div 1$$

The solution is -183.250, which is option C.

A. $[203.8, 205.3]$

205.017, which corresponds to two Order of Operations errors.

B. $[205.2, 211.4]$

208.750, which corresponds to an Order of Operations error: multiplying by negative before squaring. For example: $(-3)^2 \neq -3^2$

C. $[-185.1, -182.9]$

* -183.250, this is the correct option

D. $[-188, -183.7]$

-186.983, which corresponds to an Order of Operations error: not reading left-to-right for multiplication/division.

E. None of the above

You may have gotten this by making an unanticipated error. If you got a value that is not any of the others, please let the coordinator know so they can help you figure out what happened.

General Comment: While you may remember (or were taught) PEMDAS is done in order, it is actually done as P/E/MD/AS. When we are at MD or AS, we read left to right.

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27. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$(-2 - 8i)(6 + 7i)$$

The solution is $44 - 62i$, which is option C.

A. $a \in [-12, -5]$ and $b \in [-58, -55]$

$-12 - 56i$, which corresponds to just multiplying the real terms to get the real part of the solution and the coefficients in the complex terms to get the complex part.

B. $a \in [-70, -65]$ and $b \in [27, 40]$

$-68 + 34i$, which corresponds to adding a minus sign in the first term.

C. $a \in [39, 48]$ and $b \in [-63, -61]$

* $44 - 62i$, which is the correct option.

D. $a \in [-70, -65]$ and $b \in [-36, -27]$

$-68 - 34i$, which corresponds to adding a minus sign in the second term.

E. $a \in [39, 48]$ and $b \in [59, 63]$

$44 + 62i$, which corresponds to adding a minus sign in both terms.

General Comment: You can treat i as a variable and distribute. Just remember that $i^2 = -1$, so you can continue to reduce after you distribute.

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28. Choose the **smallest** set of Complex numbers that the number below belongs to.

$$-\sqrt{\frac{660}{6}} + 5i^2$$

The solution is Irrational, which is option B.

A. Nonreal Complex

This is a Complex number $(a + bi)$ that is not Real (has i as part of the number).

B. Irrational

* This is the correct option!

C. Pure Imaginary

This is a Complex number $(a + bi)$ that **only** has an imaginary part like $2i$.

D. Not a Complex Number

This is not a number. The only non-Complex number we know is dividing by 0 as this is not a number!

E. Rational

These are numbers that can be written as fraction of Integers (e.g., -2/3 + 5)

General Comment: Be sure to simplify $i^2 = -1$. This may remove the imaginary portion for your number. If you are having trouble, you may want to look at the *Subgroups of the Real Numbers* section.

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29. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$\frac{72 - 55i}{-1 - 2i}$$

The solution is $7.60 + 39.80i$, which is option C.

A. $a \in [37.5, 39]$ and $b \in [39.5, 40.5]$

$38.00 + 39.80i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

B. $a \in [6.5, 8]$ and $b \in [198.5, 199.5]$

$7.60 + 199.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

C. $a \in [6.5, 8]$ and $b \in [39.5, 40.5]$

* $7.60 + 39.80i$, which is the correct option.

D. $a \in [-72.5, -70.5]$ and $b \in [27, 28.5]$

$-72.00 + 27.50i$, which corresponds to just dividing the first term by the first term and the second by the second.

E. $a \in [-37, -35]$ and $b \in [-19, -17]$

$-36.40 - 17.80i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

General Comment: Multiply the numerator and denominator by the *conjugate* of the denominator, then simplify. For example, if we have $2 + 3i$, the conjugate is $2 - 3i$.

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30. Choose the **smallest** set of Complex numbers that the number below belongs to.

$$\frac{11}{5} + \sqrt{132}i$$

The solution is Nonreal Complex, which is option D.

A. Irrational

These cannot be written as a fraction of Integers. Remember: π is not an Integer!

B. Rational

These are numbers that can be written as fraction of Integers (e.g., -2/3 + 5)

C. Pure Imaginary

This is a Complex number $(a + bi)$ that **only** has an imaginary part like $2i$.

D. Nonreal Complex

* This is the correct option!

E. Not a Complex Number

This is not a number. The only non-Complex number we know is dividing by 0 as this is not a number!

General Comment: Be sure to simplify $i^2 = -1$. This may remove the imaginary portion for your number. If you are having trouble, you may want to look at the *Subgroups of the Real Numbers* section.
